U.S. Department of Energy
Energy Efficiency and Renewable Energy

federal energy management program

Navy Technology Validation (Techval)

NAVFAC
Naval Facilities Engineering Command
ENGINEERING SERVICE CENTER

NAVY / MARINE CORPS
ENERGY EFFICIENCY
SOLUTIONS TODAY FOR A BRIGHT TOMORROW
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FUPWG Spring Meeting 2008
April 15, 2008
Destin, FL

Paul Kistler, PE CEM
NAVFAC Engineering Service Center
Port Hueneme CA

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CURRENT PROJECTS

- **Cool Roof reflective roof coating**
  - *NS Pearl Harbor HI*
- **Thermal Destratifiers**
  - *NAS Oceana VA*
- **Boiler Combustion Controls**
  - *USNA Annapolis MD*
- **Sand Filters**
  - *NAS Lemoore CA*
- **Spectrally Enhanced Lighting**
  - *Navy Yard Washington DC*
- **Desuperheater**
  - *NS Norfolk VA*
  - *NAS North Island CA*
- **HVAC CO2 Controls**
  - *NAB Little Creek VA*
  - *NAVSUPPACT Mid-South TN*
  - *NB Kitsap Bremerton WA*
- **HVAC Occupancy Controls**
  - *NAS Oceana VA*
- **Electromagnetic Pulse Water Treatment**
  - *NADEP San Diego CA*
  - *NSY Puget Sound WA*
- **LED Parking Lot Lighting**
  - *NBVC Port Hueneme CA*

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COMPLETED PROJECTS

- **Duct Sealants**
  - *NSA Orlando FL*
  - *NS Newport RI*
  - *NSY Puget Sound WA*
  - *NB San Diego CA*
- **EER+ Retrofit**
  - *NSWC Corona CA*
  - *NB San Diego CA*
  - *NWS Yorktown VA*
  - *NAWS China Lake*
  - *NAWC China Lake CA*
- **Spectrally Enhanced Lighting**
  - *NBVC Port Hueneme*
- **Power conditioner**
  - *SUBASE New London CT*
- **Fuel oil fired 30KW Microturbine**
  - *SUBASE New London CT*
- **Thermal destratifiers**
  - *NSWC Crane IN*
  - *NSWCCD West Bethesda MD*
- **Magnetic Bearing Chiller Compressor**
  - *NUWC Newport RI*
  - *NRSW San Diego CA*
  - *NAS Jacksonville FL*
- **Wrap around heat pipe**
  - *NS Pearl Harbor HI*
  - *NAS Pensacola FL*
- **Boiler Combustion Controls**
  - *NB Kitsap Bremerton WA*
- **HID dimming**
  - *NBVC Port Hueneme CA*

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Reports Currently Available

- Vending Machine Occupancy Sensor
- LED Airfield Lighting
- Thermal Destratifiers
- Magnetic Bearing Chiller Compressor
- Extended Surface Air Filters
- Super T8 Lamps
- Day Lighting

Reports Currently in Final Review

- Heat Pipes
- Cool Roofs
- Duct Sealants
- Spectrally Enhanced Lighting

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- Magnetic Bearing Chiller Compressor
- Duct Sealants
- HID Dimmers
  - **What is it, how does it work?**
  - **Data from projects**
  - **Where does it work best?**

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2 ea. 60 ton chiller compressors with magnetic bearings

NAS Jacksonville FL

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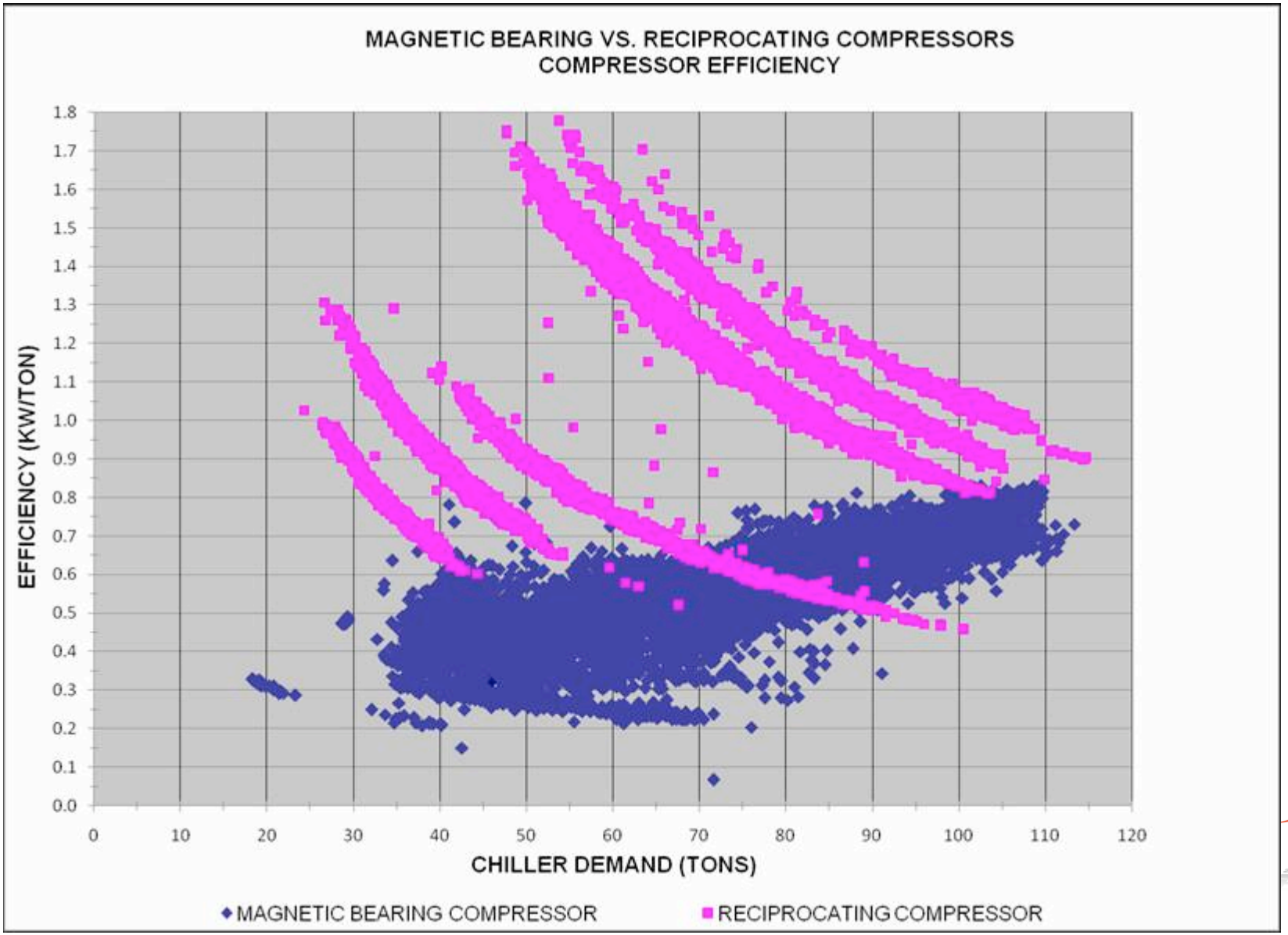

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JAX Data

	Compressor Efficacy	Plant Efficacy	Average Load	Average Compressor Power	Cooling Tower Power	Plant Power
New	.57 kW/ton	.61 kW/ton	75.4 ton	45.9kW	2.44kW	48.3 kW
Existing	1.02 kW/ton	1.04 kW/ton	76.7 ton	78.5kW	1.55kW	80.1 kW

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Cost for installation in Jacksonville

Mechanical Subcontractor (including compressor)	$95,150
DDC Subcontractor	$12,442
Total	$107,592

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The Table below is the simple payback using the incremental cost:

Project Site	Tons	Annual Energy $ Savings	Incremental Cost	Payback (years)
San Diego 2006	240	$21,206	$24,000	1.1
Newport Sep/Nov 2005	80	$26,192	$8,000	0.3
JAX 2006/2007	120	$15,358	$12,000	0.8

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Maintenance

1.	Quarterly tightening of terminal screws (could be done in conjunction with #2 once per year)	2 work-hours per service
2.	Annual blowing dust off circuit boards	2 work-hours per service
3.	Change capacitors every five years	8 work-hours per service plus $250 for capacitors

Over 10 years that would be 96 work-hours plus $500 for capacitors.

Other advantages of the compressor

- **Quiet** – In San Diego the chilled water pumps make more noise than the chiller. Could be a plus if installation is in an area where noise is an issue.

- **Light weight** – If compressor needs to be changed out, can be accomplished manually by two persons.

- **Low startup draw** – about 2 amps. Could be a plus if you are replacing or installing a backup generator since generator can be downsized to handle full load draw, not startup. Smaller generator may pay for incremental cost of compressor.

Problems

Newport

- **Thermister failed. Thermister was replaced and problem has not recurred.**
- **Automatic Expansion Valve not tuned properly. Valve was adjusted and problem has not recurred.**

San Diego

- **Insulated Gate Bipolar Transistor (IGBT) failed. Decision was made to replace compressor since it was relatively easy to do. Replacement took two hours. Problem has not recurred.**
- **Power surge damaged one of three compressors. Compressor was replaced. Manufacturer has stated that electronics have been improved since this compressor was installed.**
- **Electronics were not sealed sufficiently resulting in moisture damage. Sealing has been improved.**

Jacksonville

- **None**

Best Places To Install Magnetic Bearing Chiller Compressor

- Relatively high electric rates (> $0.06 kWh)
- Long run hours at part load
- Recip replacement is almost a no-brainer
- Where existing compressor is in need of replacement

Duct Sealing

Building 865 at the Naval Base Kitsap in Bremerton, WA

Building 1268 at the Naval Station Newport, RI

De Florez Building at NAVAIR Orlando, FL

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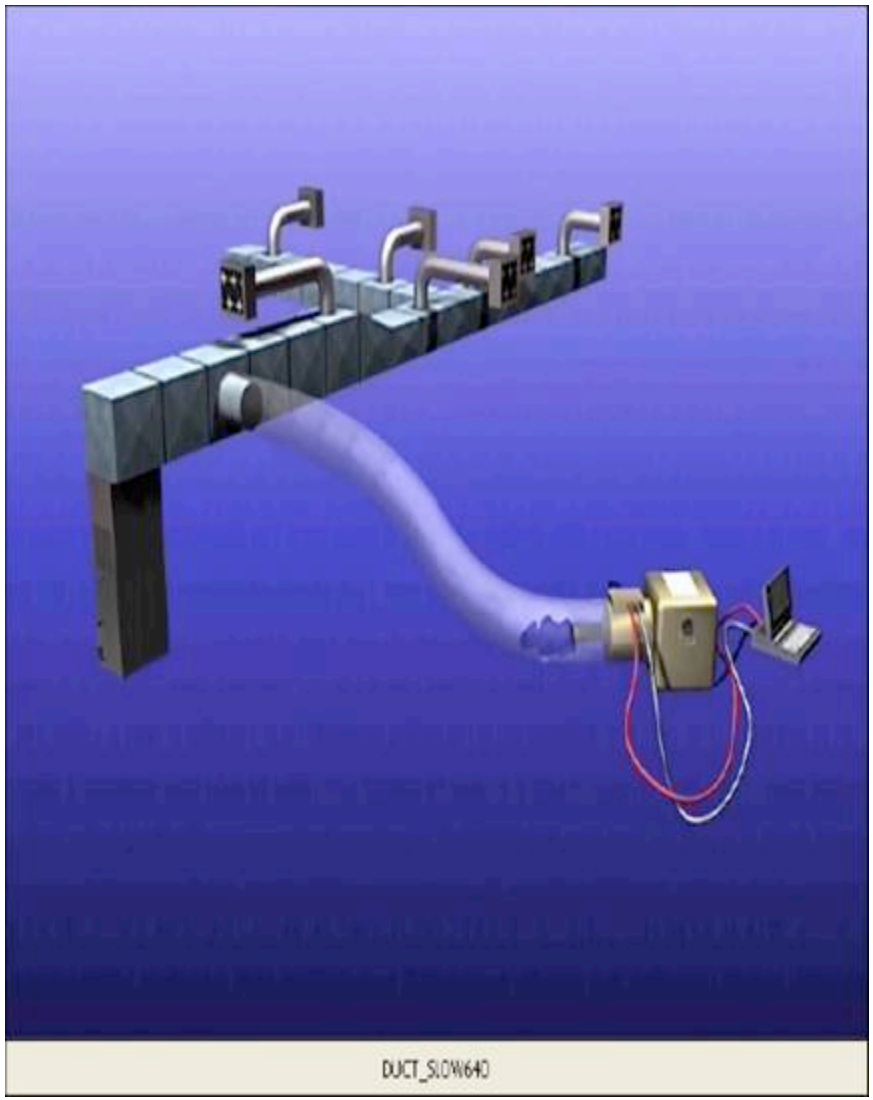
What is duct sealing?



Interior of Duct After Sealing

Economics

	De Florez Bldg Orlando	Bldg 1268 Newport	Bldg 865 Bremerton	Bldg 3339 San Diego
Annual energy savings ($/yr)	**$8,125**	**$2,880**	**$2,007**	**$2,045**
Installation Costs ($)				
-Aeroseal™	**$49,057**	**$23,701**	**$8,453**	**$21,270**
-New fan motor	**n/a**	**n/a**	**8,512**	**n/a**
-Variable-frequency drive	**n/a**	**n/a**	**4,510**	**n/a**
-Test, adjust and balance	**n/a**	**n/a**	**2,680**	**n/a**
-Total	**$49,057**	**$23,701**	**$24,155**	**$21,270**
Simple Payback (yr)	**6.0**	**8.2**	**12.0**	**10.4**

Conditions where the technology application would be most cost effective are:

- High site energy costs

- Ducts to be sealed are in unconditioned space

- Heating and/or cooling energy loads primarily met by the air distribution system. Perimeter heating will severely limit the energy savings potential of the technology

- Duct systems that are known to be leaky
  – duct blaster tests on sections of the duct systems will confirm the degree of leakiness.

HID Lighting Dimmers

IESNA Recommended Maintained Horizontal Illuminances for Open Parking Facilities			
Level of Activity	General Parking and Pedestrian Area		
	Lux (Minimum on pavement)	Uniformity Ratio (Average:Minimum)	NFESC Commissary Illumination
High	10	4:1	14.4
Medium	6	4:1	14.4
Low*	2	4:1	14.4

* This recommendation is based on the requirement to maintain security at any time in areas where there is a low level of nighttime activity.
Source: IESNA Lighting Handbook: Reference and Application, 9th Edition, figure 24-23.

Test Setup At NBVC Commissary

Parameters Measured

- kW
- Volts
- Amps
- Power factor
- kVA
- Photopic illumination
- Scotopic illumination
- CIE chromatic indices
- Current crest factor
- Voltage crest factor
- Current total harmonic distortion
- Voltage total harmonic distortion

NBVC Dimming Data

	Average Power	Average kWh/day	Illumination (Lux)	kWh savings/yr	$ savings/yr	Installed Cost	Simple Payback
Baseline	7.782	84.94	14.4				
A	5.692	62.93	11.0	8,033	964	5,506	5.7
B	6.274	69.98	12.5	5,458	655	4,377	6.7
C	5.064	56.56	10.0	10,357	1243	3,725	3.0
D	5.958	64.73	12.1	7,375	885	10,700	12.1

Payback if savings fixed at $885/yr

A	6.2
B	4.9
C	4.2
D	12.1

Where To Install HID Dimmers

- Facilities with high electrical rates (> $0.06/kWh)
- Facilities with large number of HID lights (high load). Try to match load to max load for the unit. Parking lots, hangars, street lights.
- Long hours of use (> 8 hrs/day)
- Facilities that are overlit
- Facilities with differing levels of activity

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